CHAPTER II

RECONNAISSANCE

A. GENERAL

Land stations in the tropical Pacific are sparse. Although additional observing units are expected to be installed at strategic locations in the future, the stations will continue to remain widely scattered. Ships which transmit observations are usually concentrated along the shipping lanes which generally do not pass through the areas of formation and development of tropical systems. Also, ships which are near a system will normally take evasive action as soon as the first warning is received. The pictures received from the ESSA II and NIMBUS Satellites have proven to be a tremendous aid, especially in first locating suspect areas. However, the satellites cannot report the winds, pressures, and other important data needed to properly analyze a tropical cyclone. Aerial reconnaissance thus remains the only method available which provides sufficient surface and upper air data for complete and proper analysis of a tropical cyclone.

Reconnaissance aircraft are able to remain in the area of a storm to provide an accurate position and to report the various storm characteristics such as eye shape, intensity, etc. By taking dropsondes or making ascent or descent soundings the aircraft is able to obtain the lapse rate profile to the surface, heights of standard levels, sea level pressures, and temperature and dew point at any level.

The accuracy of tropical warnings is directly related to the quality and quantity of reconnaissance data received from the aircraft. Continuous surveillance of tropical systems is of the utmost importance in order to insure that warnings are issued in time to facilitate proper preparations for safeguarding life and property.

B. RECONNAISSANCE RESPONSIBILITY

During 1966 two squadrons were assigned the responsibility of tropical cyclone reconnaissance to meet the requirements of the Joint Typhoon Warning Center, Guam. These squadrons were the U. S. Navy Airborne Early Warning Squadron One (VW-1), equipped with EC121K aircraft based at the Naval Air Station, Agana, Guam and the U. S. Air Force 54th Weather Reconnaissance Squadron (54WRS), equipped with WC-130 aircraft based at Andersen Air Force Base, Guam.

C. EVALUATION OF DATA

During the 1966 season four fixes per day were normally scheduled on typhoons and tropical storms. Tropical Depressions were scheduled for one or more fixes per day depending on location, potential, and feasibility of radar coverage.

In general, low or intermediate (1500ft or 700mb) level fixes were made by VW-1 at 0900Z and 1500Z and intermediate (700mb) level fixes were made by the 54WRS at 2100Z and 0300Z. High level (500mb) fixes were made on storms over high terrain. In addition to the fixes, both squadrons flew synoptic and investigative flights throughout the year.

Aerial reconnaissance can be divided, according to data gathered, into three categories: peripheral data, eye data from penetration, and eye data from radar.

Peripheral data is all information reported enroute to and outside the eye of the storm. It includes weather, sea level pressure if aircraft is at low level or pressure-height if at mid or high level, a complete description of clouds including types, amount and height of bases and tops if feasible, flight altitude wind, temperature and dew point, and the surface wind if the sea surface is visible. Dropsonde data were also provided. This same type of data is provided on all synoptic tracks and investigations. The WC-130 usually flew at 700mb but on occasion flew at 500mb, or 1500 ft. EC121K aircraft normally flew either at 1500 feet or 700mb, but at times mountainous terrain required the flight to be at 500mb.

Eye data from penetration includes all information reported in peripheral data plus eye size, shape, description, slope, cloudiness, maximum flight level wind, surface wind and surge, if any, and other remarks which might be of help to the forecaster such as feeder band description, direction and speed of movement of the center, etc. If possible, a dropsonde is also made in the eye.

Eye data from radar provide a description of the radar eye and its locations, including description of spiral bands and height and width of the wall clouds. Also included is the aircraft position at the time the radar observation is taken and the maximum observed winds if possible.

On all eye messages a center selection evaluation of either "Positive", "Fair" or "Poor" is given along with an estimate of the navigation accuracy of the fix and a statement of the type of navigation fix used by the aircraft. These were used by JTWC as a guide in evaluating fix accuracy. With radar fixes from a considerable distance, attenuation can distort the radar image; therefore, this must be considered when evaluating the fix.

During 1966, daylight penetrations were made on all but a few of the most severe storms. When possible, EC121K aircraft also penetrated the storms for the night fixes. These penetrations were normally made at 1500 ft or below on the evening fix and 700mb at night.

AIRCRAFT RECONNAISSANCE DATA

(Number of Fixes and Investigations)

1961	1962	1963	1964	1965	1966
350	496	465	772	666	674

In addition there were 197 synoptic tracks flown by the two squadrons during 1966.

The information received from the aircraft was continually checked for consistency and accuracy. Where possible, JTWC graphs and other aids were used to check and compare data with previous reports. Verification was immediately requested from the observing aircraft on any apparent discrepancy in the data.

D. COMMUNICATIONS

The primary means of communications between ground and reconnaissance aircraft was voice single sideband for 54WRS. VW-1 commenced the year using radiotelegraph (CW) and converted to voice single sideband early in the season. Andersen Airways (AIE2), Guam was the primary air to ground station for aircraft using single sideband. Naval Communications Station, Guam was the primary station for aircraft using CW. Clark Airways, (AIC2), Republic of the Philippines, Fuchu Airways (AIF2), Japan, and Kadena Airways (AID2), Okinawa, were the secondary air to ground stations. Naval Communications Station, Philippines, and Naval Communications Station, Japan acted as secondary CW stations. Data received by AIE2 and NCS Guam were relayed to JTWC by the local circuit 3L28. This circuit also connects VW-1, 54WRS, and Naval Air Station, Agana, Guam. Data received by AIC2, AIF2, and AID2 were normally phoned to JTWC, followed by a message transmitted through the Defense Communications System. Data received at the Naval Communications Stations in the Philippines and Japan were relayed to JTWC by the NTX system.

When aircraft were in contact with AIE2 or NCS Guam the eye reports were normally received by JTWC in sufficient time to allow the forecaster to make a comprehensive study of the information prior to warning time. However, when the aircraft had to communicate through one of the secondary stations there were many cases of excessive delay in receipt of the eye data. In some instances,it was not received until after warning time.

This problem was alleviated to a certain extent in the South China Sea area by requesting the air to ground station to pass the eye data to Fleet Weather Facility, Sangley Point immediately after receipt. Sangley would then relay the data to JTWC over the teletype circuit connecting FWF, Sangley Point and FWC/JTWC, Guam. The air to ground stations also aided greatly by phoning the eye reports to JTWC via the Joint Overseas Switchboard. If, however, the secondary ground stations relied solely on the NTX system in transmitting eye data to JTWC, the excessive delay in most cases made it impossible for a thorough analysis of the information before warning time.

Late in the season a test was conducted jointly by VW-1, NCS, Guam, and JTWC in which reconnaissance data were transmitted directly from the aircraft to JTWC utilizing receivers and transmitters at NCS Guam. This method proved to be efficient and quite acceptable and more tests are planned for the future. If the necessary equipment and frequencies to be used exclusively for Tropical Cyclone Reconnaissance are approved by CNO it is expected that practically all communication problems presently encountered will be reduced to a minimum.

The following statistics show the delays between time of fix and time of first receipt at JTWC. The methods used in getting the fix to JTWC are shown for comparison.

DELAY IN RECEIPT OF RECONNAISSANCE FIX DATA FOR 1966

METHOD	NUMBER OF CASES	MAX DELAY TIME	MIN DELAY TIME	AVG DELAY TIME
3L28	413	3 HRS 04 MIN	15 MIN	55 MIN
NTX	24	4 HRS 22 MIN	1 HR 15 MIN	2 HRS 11 MIN
SANGLEY PT POINT TO POINT	05	2 HRS 47 MIN	1 HR 25 MIN	2 HRS 03 MIN
TELEPHONE	123	4 HRS 33 MIN	FEW MINUTES	1 HR 09 MIN

The following are some revealing statistics on communications delays encountered in 1966 along with figures from previous years for comparison.

A COMPARISON OF DELAY TIME WITH PREVIOUS YEARS

	1964	1965	1966
MAX DELAY TIME	6 HRS 45 MIN	60 HRS 09 MIN	4 HRS 33 MIN
AVG DELAY TIME	1 HR 14 MIN	1 HR 05 MIN	1 HR 02 MIN
MIN DELAY TIME	8 Minutes	9 Minutes	"Few Minutes"
% OF EYE MESSAGES DELAYED MORE THAN 1 HOUR	59%	39%	38%
NUMBER OF FIXES RECEIVED AFTER WARNING TIME	46	34	30
% RECEIVED AFTER WARNING TIME	8%	6%	5%

E. SUMMARY OF RECONNAISSANCE SUPPORT

In an effort to make the crediting of the reconnaissance effort more objective and meaningful, a system was devised in 1965 to credit fixes and investigations. The same system, with minor changes to group fix and investigative flights together was used this past season. First of all, the problems of why a fix was early, late or missed completely, although of interest and concern to JTWC, belong to the Tropical Cyclone Reconnaissance Coordinator (TCRC). The time of warning and inherent communications delays were the determining factors used in the crediting scheme. Obviously it would be desirable to have the fix made as near warning time as possible, but,the communications delays have been such that fixes must be made about 3 hours before warning time. This usually allows ample time to digest the information after receipt of the data. The crediting system is described below.

DEFINITIONS OF FIX CREDITS

CLASS	DEFINITION	
1	Full Credit	From 1 hour before to ½ hour after levied time. (Includes fixes made on investigative flights.)
2	Full Credit	No center or eye found, but otherwise falls into Class 1 above. (Includes investigative flights on which no center was found.)

CLASS	DEFINITION	
3	Early/Late	Greater than 1 hour but not more than 1½ hours before levied time or greater than ½ hour but not more than 2 hours after levied time.
4	Very Early or Very Late	Greater than 1½ hours before or 2 hours after levied time.
5	Attempted but missed fix	Recon provided some useful peripheral data but no fix was made. Reasons may include clearance problems, mechanical trouble, low fuel, etc., etc.
6	Missed Fix	Due to complete abort, aircraft was airborne but provided no useful data, aircraft never got airborne, squadron unable to provide fix for unspecified reasons.

This system, although as objective as possible, requires subjective evaluation of some fixes. For example, a plane could be in the area assigned on time when the storm had accelerated unexpectedly and could not be reached within the normal time limits by the reconnaissance aircraft. In this case, full credit would be given with no penalty for being late.

Applying the above criteria for the 1966 season, the following statistics are obtained:

EVALUATION OF TIMELINESS OF RECONNAISSANCE FOR 1966

FIXES		INVESTIGATIONS		FIXES & INVESTIGATIONS
Class	Number	Class	Number	TOTALS
1	513	1	40	553
2	14	2	80	94
3	20			20
4	7			7
5	0			0
6	10			10